# Tracking to Retain Higher-Income Students: Evidence from the Addition of Advanced Courses *

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**Abstract**

Tracking in public schools has the potential to reshape classroom and school composition by attracting or retaining upper-income and higher-achieving students. However, tracking could also exacerbate sorting by student income and test scores within schools. To examine how tracking may influence classroom income and test-score composition, I exploit variation in the timing of an Advance Placement (AP) course addition within specific school subjects. I find that the introduction of an AP course does not reduce lower-income students' exposure to upper-income classmates; if anything, it increases their exposure. This increase is driven by a rise in the overall share of upper-income students at the school following the addition of an AP course, offsetting increases in sorting by income. These findings provide new insights into how tracked courses can influence school environments, connecting the school choice and tracking literature, and contributing to the broader understanding of the equity implications of advanced courses.

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# 1 Introduction

Recent research has established a strong relationship between cross-income friendships in neighborhoods and economic mobility (Chetty et al., 2022). In my work, I found that lower-income students in high school cohorts with a higher share of upper-income peers were slightly more likely to enroll in college and earn higher wages in early adulthood (Mallah, 2024). Independent of economic outcomes, cross-group interactions may also be important for social cohesion (Corno, La Ferrara,and Burns, 2022; Rao, 2019; Carrell, Hoekstra, and West, 2019). How schools are organized could facilitate or hinder friendships between lower- and upper-income students. For instance, schools may inadvertently deepen inequalities by creating categories—such as gifted programs—that sort students by income (Kerckhoff, 1995; Domina, Penner, and Penner, 2017). While previous studies have explored the effects of school choice policies on segregation (see Phillips et al., 2015; Marcotte and Dalane, 2019; Alcaino and Jennings, 2020; Monarrez, Kisida, and Chingos, 2022), we know far less about how specific school factors, such as course offerings, influence cross-income exposure.

One common policy lever in schools is the choice of courses to offer. The equity implication of tracking through the addition of advanced courses is particularly salient in policy discussions.[1] The assumption underlying many of the news headlines is that advanced courses would create separate tracks that increase economic segregation in schools—reinforcing existing inequities. This between-classroom sorting mechanism is usually the center of policy debates about tracking. Those debates typically ignore the potential between-school sorting following the addition or removal of an advanced course. For example, higher-income students may elect to leave public schools when advanced courses are removed. While some research has addressed the impact of advanced courses on college enrollment (Jackson, 2014; Cohodes, 2020; Conger, Long, and McGhee Jr., 2020), these studies overlook the potentially mediating effect of advanced courses on exposure to higher-income and higher-achieving students. In this paper, I test the hypothesis that schools may track to retain or attract higher-achieving and/or upper-income students by presenting evidence on the impact of the addition of advanced courses on lower-income students' classroom income and achievement composition.

The change in lower-income students' classroom composition may arise from two opposing mechanisms: 1) the addition of an advanced course might alter the proportion of upper-income students enrolled in that subject (a "composition shift"), and 2) it might increase income-based sorting within the subject (a "sorting change"). The introduction of an advanced course might decrease lower-income students' share of higher-income classmates by increasing within-school sorting by income. Increased income-based sorting

[1] Recent news articles: https://www.bostonglobe.com/2023/07/14/metro/cambridge-schools-divided-over-middle-school-math/; https://www.baronnews.com/2023/03/21/some-california-high-schools-remove-honors-classes-due-to-equity-issues/; https://www.virginiamercury.com/2021/04/26/virginia-isnt-eliminating-accelerated-math-courses-but-its-one-of-many-states-rethinking-math-education/

following the addition of an advanced course would happen if lower-income students are less likely to enroll in an advanced course compared to the counterfactual course. Lower-income student's lower likelihood of enrolling in advanced courses may be explained by differences in parental involvement (see Kalgorides and Loeb, 2013; Lareau, 1987; Lareau, 2000; Useem, 1992; Barg, 2012) or differences in academic preparation. Conversely, the addition of advanced courses could enhance lower-income students' exposure to upper-income peers by making the public school more appealing to higher-income families. In this scenario, higher-income students might be less inclined to transfer to private schools and more likely to enroll in subjects like Fine Arts when advanced courses are available. Domina et al. (2017) observe that schools with more advantaged student populations tend to increase tracking in response to policy pressures. Epple, Newlon, and Romano (2002) present a theoretical model in which public schools track to retain higher-achieving upper-income students. By tracking, they suggest, schools are able to retain higher-achieving upper-income students; however, upper-income lower-achieving students are likely to leave tracked public schools to attend less tracked private schools.

A concern with evaluating the impact of the addition of advanced courses is selection. Schools might introduce new courses for various reasons reflecting changes in the student populations (demand-side factors) or administrative priorities and teacher experience (supply-side factors). While demand/supply changes may determine course offerings, the precise timing of an advanced course's introduction may be quasi-random. Administrative constraints, such as securing a qualified teacher, completing the AP Course Audit, and obtaining approval for the "AP" designation from the College Board (TEA, 2023), can introduce delays in providing the course.[2] To isolate the impact of adding an advanced course, I utilize a difference-in-differences approach, leveraging variations in the timing of the first advanced course addition to a subject area within a school between 2004 and 2022 in Texas Schools. The assumption necessary for establishing a causal link is that treatment and comparison schools would have followed similar trends in lower-income students' share of upper-income students the absence of the advanced course addition. Consistent with this assumption, I find no evidence of pre-existing trends in share of upper-income classmates in lower-income students' classrooms prior to the introduction of AP courses in a school subject, suggesting that the observed effects are indeed attributable to the new coursework.

I use data from the Texas Education Research Center (2004-2022) which includes information on student test scores, course enrollments (and class assignments starting in 2011) and teacher assigned. To capture student income, ideally, I would have parental income for all enrolled students. In the absence of this, I

[2]College Board approval is typically granted within 60 days. Schools may assign the "AP" designation before official authorization, provided they are in the process of obtaining it. Approval is teacher-specific, the college board requires a new audit submission if a different instructor is assigned to the course (College Board, 2025).

measure economic disadvantage using the proportion of years each student in on free/reduced lunch status.[3] I categorize students into three income groups: those who are always, sometimes, or never eligible for free/reduced lunch. This classification effectively captures variations in parental income, with financial aid reported average adjusted parental incomes of $141,686 for those never eligible, $51,406 for those sometimes eligible, and $27,305 for those always eligible (Mallah, 2024).[4] I refer to to the "never eligible" group as "higher/upper-income" (24% of students) and the "always eligible" group as "lower income" (29% of students).

My primary outcome of interest is the share of upper-income students in lower-income students' classrooms. In this paper, I focus on the impact of adding AP courses, as they represent the majority of advanced offerings. I define treatment as the first addition of an AP course in a high school subject area (e.g., sciences), while control schools are those where an AP course is never added in that same subject area (e.g., sciences) between 2004 and 2022.[5]

My findings indicate that the addition of an AP course increases lower-income students' exposure to higher-income classmates. Specifically, I observe a 1 percentage point (9%) increase in lower-income students' share of upper-income peers ($p < 0.001$). A 1 percentage point increase in exposure to upper-income students is about one-third the average potential gain in exposure to upper-income students had students been randomly assigned to schools in a district (Mallah, 2024). This finding coupled with Jackson (2014) finding that incentivizing AP course enrollment increases students' college enrollment and wages suggests that advanced courses may improve school socioeconomic integration and equity in long-term outcomes. This is counterintuitive, if we assume that the only mechanism by which the addition of advanced courses may impact lower-income students' classroom exposure to upper-income peers is by changing student sorting within schools.

I find evidence for the two counter mechanisms ("composition shift" and "sorting change"). Following the introduction of an AP course, the share of higher-income students in treated subjects rose by 1.1 percentage points. However, I also observed an increase in income sorting; the difference in the share of upper-income classmates in the treated subject area between upper- and lower-income students increased by 0.5 percentage points. This suggests that while sorting by income increased post-AP course addition, the overall exposure of lower-income students to upper-income peers also rose due to the influx of higher-income students in these

[3]To identify the proportion of years on free/reduced lunch, I use all years from 2004 to 2022. This definition of economic disadvantage builds on Michelmore and Dynarski (2017), who find that the number of years on free/reduced lunch captures student economic disadvantage better than a binary measure of economic disadvantage based on one year of free/reduced lunch eligibility status.

[4]Their median parental income is $117,119, $39,145 and $22,000, respectively. The median income in Texas based on census data (2019-23) is around $76,290 (Census, 2023).

[5]I exclude school subject areas that at any point before 2012 had an AP course (always-treated). Once an AP course is added, a school subject area is considered treated for the remainder of the years.

subjects.

The relationship between AP coursework and exposure to higher-income students may vary by subject area. For example, in subjects like math, where enrollment in an AP course might highly depend on prior preparation, lower-income students may be less likely to benefit from the addition of an AP course. My findings indicate that the increase in exposure to upper-income peers primarily occurs in four subject areas: science, foreign language, technology and fine arts, with no evidence of an effect in math.

I find that the addition of an AP course increases the share of upper-income students in the district, with no detectable impact on other schools within the district. In other words, the addition of an AP course appears to attract higher income students to the district to enroll in the school offering the AP course. The increase in the share of upper-income students in the district suggests that the impact of AP courses on the share of upper-income students is driven by higher-income students who would have otherwise attended private schools or public schools in other districts. This finding aligns with Epple, Newlon, and Romano (2002) prediction that school tracking could attract higher-income students to public schools. However, while their model predicts that this increase would primarily involve higher-income, higher-achieving students, my results indicate a different pattern. Specifically, the increase in the share of upper-income students appears to be driven by higher-income students who scored below the 75th percentile on their grade 8 tests.

These findings highlight the importance of considering not only how course offerings affect student sorting within schools but also how they influence overall school composition by attracting and retaining higher-income students. It suggests that the addition of AP courses will not necessarily decrease lower-income students classroom share of upper-income peers through increased sorting by income. The identification strategy employed in this study also provides a framework for examining how various course offerings impact student demographics and long-term outcomes, enabling schools to make more informed decisions about which courses to offer and to whom.

An important limitation of this study is that there may be other subject and school changes happening alongside the addition of an AP course. For instance, a school might hire more experienced teachers who improve instructional quality, and these teachers may also be more likely to introduce an AP course. In such cases, the observed impacts could be driven by improved teacher quality rather than the AP course itself. Nevertheless, it suggests that the package of changes that happen alongside AP course addition that the typical school undergoes does not decrease lower-income students' exposure to upper-income peers, instead, it (marginally) increases lower-income students share of upper-income classmates.

This paper contributes to the literature on advanced coursework and tracking. There are a few papers on

the impact of advanced coursework on students' college enrollment (Jackson, 2014; Cohodes, 2020; Conger, Long and McGhee Jr., 2020; Owens, 2024). These papers do not examine the (potentially) mediating impact on exposure to higher-income students. Cohodes (2020) finds providing an advanced track program in schools for students above an academic cutoff increases college enrollment for those on the margin, particularly for Black and Latin-American students. The results are for a particular group of students: those on the margin. It is not clear how this policy impacted students who did not get into the program: lower performing students on the margin. Similarly, Jackson (2014) finds offering students and teachers incentives to enroll in AP courses increased AP course taking and college enrollment. On the other hand, Conger, Long and McGhee Jr., (2020), find that randomly offering an AP science course in 23 schools had no effect on students' plans to apply to college or on their entrance exam. They also find that students who enroll in AP courses end up enrolling in less selective colleges. This suggests the impact of access to advanced coursework may vary depending on how it is offered and the students' baseline academic performance. In this paper I examine how the impact of AP course addition may change school composition and impact lower-income students college enrollment and wages, as well as how this impact may vary by lower-income students' likelihood of enrolling in an AP course when offered.

The closest paper to my work is Owen (2024), which uses variation in the number of AP courses within a school across cohorts to identify the impact of AP course availability on college enrollment. Owen (2024) finds that AP courses primarily benefit high-achieving students in terms of college enrollment. My study differs in several important ways. First, I focus on the addition of the first AP course in a subject area (extensive margin) rather than the total number of AP courses offered (intensive margin), this allows me to examine whether changes in cohort composition are driven by the addition of an AP course or by other factors that predate its addition. Second, my analysis extends beyond the scope of Owen (2024) by examining the impact of AP on school composition and lower-income students' exposure to upper-income peers.

The findings also contribute to the literature on school tracking. Prior work provides evidence of within-school by academic performance, race and income (e.g., Antonovics, Black, Cullen, and Meiselman, 2022; Clotfelter, Ladd, Clifton, and Turaeva, 2021; Dalane and Marcotte, 2022; Clotfelter, Ladd, and Vidgor, 2002). While it is known that sorting within schools occurs, it is unclear how school course offerings impact the level of sorting within schools and lower-income students' exposure to upper-income peers. Antonovics et al. (2022) find that Texas middle schools with more curricular differentiation, measured by the number of math courses offered, tend to have higher levels of sorting by test scores. However, the higher level of within school sorting may be driven by factors correlated with the number of math courses offered in a school, like changes in the share of upper-income and/or higher-achieving students. The literature on school tracking

also does not take into account the potential impact of differentiated courses on parent's choice of which school to enroll their kids in, and in turn the schools' income composition. Therefore, the overall effect on lower-income students' exposure to upper-income classmates remains unclear; tracking may simultaneously raise the proportion of upper-income students in the school by making the school more attractive to higher income households. In this paper, I use variation in the timing of an advanced course's introduction in a subject area within a school to address selection concerns. I document the impact of adding an advanced course on the composition of the subject area within the school and the rate of income-based sorting to capture the overall effect on exposure to upper-income students.

The paper is organized as follows. In Section 2 presents the data used and context. Section 3 presents the identification strategy. Section 4 reports the main findings and section 6 concludes the paper.

## 2 Data and Context

I use longitudinal administrative data from the Texas Education Research Center (ERC) that links student data from the Texas Education Agency (TEA) with data from the Texas Higher Education Coordination Board (THECB) and Texas Workforce Commission (TWC). These TEA data span from 2004 to 2022, covering student test scores, course enrollments (including class assignments from 2011 onward), demographics, attendance, graduation, and teacher assignments (including teacher certification and demographic information).[6]

To approximate student income levels, I use the proportion of years a student is eligible for free/reduced-price lunch as a measure of economic disadvantage.[7] Students are categorized into three income groups: always, sometimes, and never eligible for free/reduced-price lunch.

The categorization based on years in free/reduced lunch status effectively captures variation in parental income, as indicated in previous research (Michelmore and Dynarski, 2017; Mallah, 2024). Students who applied for financial aid for college have to report their parental gross income. Among students who applied for financial aid, average parental income for those who are never, sometimes, and always eligible for free/reduced lunch is $141,686, $51,406, and $27,305, respectively, with median incomes of $117,119, $39,145, and $22,000.[8] For simplicity, I refer to students who are never on free/reduced lunch as higher- or upper-

[6]Test scores are primarily based on standardized grade 4 and 8 TAKS (2007–2011) and STAAR (2012–2018) reading and math tests. In this version of the paper I will not use the college enrollment and wage data and will only focus on the impact on cross-income exposure.

[7]This calculation uses data from all available years, 2004 to 2022.

[8]These averages represent students with financial aid data—a select group of students—and may be upper bounds for those always on free/reduced lunch. Financial aid data are available for 52%, 35%, and 30% of students in the never, sometimes, and always eligible groups, respectively.

income students, and those always on free/reduced lunch as lower-income students. In this paper I focus on lower-income students since we are motivated by the relationship between cross-income friendships and economic mobility, and how school policies may impact lower-income students' exposure to higher-income peers.

In Texas high schools, students take an average of eight courses per year. They typically enroll in advanced courses during grades 11 and 12, averaging 1 and 1.6 advanced courses, respectively, per grade. The largest advanced course category (around half of all advanced courses) are Advanced Placement (AP) courses. Students also take around two dual-credit courses in grades 11 and 12; however, most dual-credit courses are not classified as advanced by Texas state standards. Table 1 provides a summary of courses taken by high school students in grades 9–12.

Schools offer an average of 97 courses per academic year, including approximately 13 advanced courses, of which 7 are typically AP courses as shown in Table A3. Courses are classified into 10 main subject areas: English Language Arts (ELA), Mathematics, Science, Social Studies, Foreign Language, Fine Arts, Technology Application, Physical Education and Health, Business Education, and Career and Technical Education (CTE). Advanced courses are generally offered in the first seven subject areas.[9]

## 3 Identification Strategy

To evaluate the impact of introducing an advanced course in a given subject area, I exploit variation in the timing of the initial addition of an advanced course across schools and subject areas. The core assumption of this difference-in-differences (DiD) design is that the exact timing of a school's adoption of an advanced course in a subject area is as good as random—specifically, that it is not related to any unobserved changes in student outcomes across cohorts.

Consider, for example, School $A$, which introduced an Environmental Systems AP course in 2014 after previously offering no AP science courses, while the comparison school, School $B$, did not offer any advanced science courses between 2011 and 2022. The impact of adding the AP course in 2014 is estimated by comparing the change in exposure of lower-income students to upper-income students in School $A$ from after 2014, relative to the change in School $B$ over the same period (2014-2022). For this difference to capture the effect of adding the AP course, it must hold that, absent the AP course, trends in exposure to upper-income students would have been similar across Schools $A$ and $B$. This assumption is more plausible if Schools $A$ and $B$ had similar trends in exposure before the AP course was added in School $A$ (i.e., 2011-2013). In

[9]The median number of courses offered in a school year is 71 courses, including a median of approximately 6 advanced courses.

section 3 I examine supply and demand factors that may lead schools to add an AP course. I focus on AP courses, as they are the largest category of advanced courses and make up more than half of advanced courses.

In line with this example, I define treatment as the first-time addition of an AP course in a high school's subject area. Schools tend to introduce more AP courses after the first time they add an AP course in a subject, averaging around 1.5 AP courses by the fourth year. First, I identify AP course offerings across subject areas from 2004 to 2022. I focus on schools that add an AP course after 2011 because I only have classroom-level data starting in 2011—38% of high schools in Texas add an AP course for the first time between 2011 and 2022 in at least one subject area. I include seven subject areas where AP courses may be introduced: social studies, English language arts, science, math, foreign language, fine arts, and technology.[10] In a given subject area, the share of schools that add an AP course for the first time in that subject between 2011 and 2022 ranges from 7% in English language arts, math and social studies to 16% in technology. Control (or comparison) school subject areas are defined as those in which no AP course was added during the observation period (2004-2022). I exclude any school subject areas that offered an AP course before 2012 (always-treated).

Once a subject area within a school adds an AP course, it is considered treated in all subsequent years. The sample covers 4,635 school-subject areas across 1,339 schools, with 890 school-subject areas treated. The primary analysis is conducted at the student subject-area level, observing each student once in a subject-area per year (the outcome is based on the average proportion of upper-income students across classrooms in a subject-area). This framework is represented in Equation 1:

$$Prophighincome_{isat(-i)} = \sum_{t=-11}^{10} \beta_t AdvancedSection_{sat} + \delta_y + \delta_{at} + \delta_{sa} + \epsilon_{isat} \tag{1}$$

where $\beta_t$ captures the impact of adding an advanced course to subject area $a$ in school $s$ on lower-income students' exposure to upper-income classmates. $AdvancedSection_{sat}$ equals 1 from the year $t$ that an AP course is introduced in the subject area, with all subsequent years considered treated. The primary outcome, $Prophighincome_{isat(-i)}$, is defined as the proportion of upper-income students in the classrooms of student $i$ in subject area $a$ of school $s$ in year $t$, excluding student $i$'s own income status.[11] Equation 1 is estimated separately for upper- and lower-income students to assess differential impacts on each group's exposure to upper-income peers.

[10] The most taken course in the technology subject area is computer science. Other technology courses include web design, animation and robotics.

[11] I also look at share of total classmates that are upper-income across subjects in student $i$'s school.

The model includes subject-year fixed effects, $\delta_{at}$, which control for any time-varying changes in the proportion of upper-income students within a subject area, serving as the standard time fixed effect in a DiD model. I also incorporate school-subject fixed effects, $\delta_{sa}$, to capture baseline differences in exposure to upper-income student in a school subject. Standard error estimates are clustered at the school level.

As shown in Figure 1 panel (b) about 20% of schools that added an AP course added the course in their second year of operation. Because new schools are likely to be experiencing multiple changes in their first years of operation, in my main specification I control for number of years school has been open since 2004 ($\delta_y$). I also run the main analysis on a subset of schools that are more established–have been open for four or more years by 2011–as a robustness check.

To identify $\beta_t$ from Equation 1, the key assumption is that changes in the proportion of higher-income students in a classroom are driven by the introduction of an AP course. This assumption would be invalid if treated school subjects experienced concurrent increases in upper-income enrollment or if other school-level changes (e.g., hiring of experienced teachers, changes in school leadership) correlated with AP course introduction were driving the observed effects. While I can examine pre-trends to test for compositional changes, unobserved simultaneous changes at the school level cannot be fully ruled out. I provide some suggestive evidence using data on teachers that the impact is not driven by changes in teacher quality or general expansion of the number of courses offered, but acknowledge the potential for other unobserved confounding factors like changes in school principal or parent student association involvement.

A potential concern with the traditional difference-in-differences design when treatment timing varies is that treatment effects may be gradual and heterogeneous, making [previously] treated units poor comparison units. To address this concern, I estimate treatment effects separately for each treated unit based on the timing of when an advanced course is added and only use never-treated school-by-subject-$a$ cells as the comparison group. I then take the weighted average of those estimates.[12] This approach applies the stacked difference-in-differences estimator proposed by Callaway and Sant'Anna (2021), which corrects for biases in traditional DiD designs caused by heterogeneous treatment effects and staggered treatment timing.

Table 2 summarizes the demographics of students in always treated (schools that are always observed to have an AP course in subject), later treated and control school subjects. Control and later treated school subjects tend to have slightly fewer higher-income students than always treated school subjects (24% and 26% in control and later treated subjects, compared to 28% in always treated subjects). Always treated schools appear to have slightly more Black and Hispanic students (14% and 51%, respectively) compared

[12] I use the regression weighting of the coefficients where the weights are based on the variance and number of units in each treatment group. This weighting method tends to over weight units treated in the middle of the time period. The main estimates are not sensitive to weighting by the number of observations only.

to control and later treated schools (9% and 12% Black students, and 40% and 47% Hispanic students, in control and later treated schools, respectively). Table A4 in the appendix summarizes the number of courses offered, number of students, and the share of upper-income students for each of the control and later treated schools by subject area. Since the treatment is defined at the subject level, schools could have some treated subjects and some never treated (control) subjects.[13] The DiD identification strategy does not require later treated and control school subjects to be identical, but rather that, in the absence of AP course addition, they would have exhibited similar trends.

## 4 Supply and Demand-Side Changes Leading Up to the Addition of an AP Course

To better understand and interpret the results, we need to examine the factors that may lead schools to add an AP course in a given year. The Northwest Independent School District in Texas states on its website that "Campuses base decisions to offer courses by considering the number of requests from students and the availability of qualified staff." Administrative constraints that may limit a school's ability to offer an AP course may include finding a teacher who is both able and qualified to teach the course and completing an AP course audit requirement to get approval for the "AP" designation from the college board (TEA, 2023). That said, these administrative constraints are unlikely topose significant barriers. The college Board typically grants approval for the AP course designation 60 days after submitting an AP course audit, and schools may assign the "AP" designation before receiving official authorization, provided they are in the process of obtaining it (College Board, 2025).[14] Additionally, Iatarola, Conger and Long (2011) find that in Florida the number of advanced (AP and IB) courses a school offers is primarily driven by having a large enough number of high-achieving students; the number and qualifications of teachers, in contrast, appear to play a minor role.[15]

In the absence of data on student requests for AP courses or detailed teacher qualifications (beyond years of experience),[16] I analyze potential shifts in student income and achievement composition within school subjects leading up to the addition of an AP course (demand-side changes). It is plausible that an increase

[13]The student demographics in treated school subjects are based on the full sample of years 2011 to 2022. A school can have both treated and control subjects.

[14]Approval is teacher-specific; the College Board requires a new audit submission if a different instructor is assigned to the course (College Board, 2025).

[15]They determine the relative importance of the number of students versus the number of teachers by running a cross-sectional probit regression, using these variables along with a vector of other student characteristics, with the number of AP courses offered by the school as the outcome.

[16]There is no clear description of what qualifies a teacher to teach an AP course besides having to submit for an AP course audit to offer an AP course. In Texas, I find no evidence that AP course teachers are more/less experienced than other teachers in the same school.

in the proportion of higher-income students or students with stronger academic preparation could drive demand for AP courses. These students may be more likely to request advanced courses, prompting schools to introduce them.

I also investigate potential shifts in teacher experience or the arrival of new administrators before the addition of an AP course (supply-side changes). For instance, a newly hired teacher might advocate for adding and teaching an AP course. Similarly, a new principal with a strong belief in the value of AP courses might prioritize introducing them. However, the distinction between supply- and demand-side factors is not clear. For instance, an increase in student requests for AP courses might lead to the hiring of a new teacher with the requisite qualifications to teach them.

There does not appear to be an increase in the share of upper-income students or higher-achieving students prior to the addition of an AP course, as shown in Figure 2. Higher-achieving students are defined as those scoring in the top 25th percentile of their grade 8 reading or math test scores, based on the distribution of student test scores in the full sample for a given year. However, average standardized math test scores for students show an upward trend prior to the addition of an AP course and continue to improve afterward, as depicted in Figure 2. This pattern suggests that improved math preparation among students may increase the likelihood of a school introducing an AP course.

Additionally, schools appear more likely to hire a new teacher in the year preceding the addition of an AP course. The share of new teachers——defined as those who did not work at the treated school in the prior year—peaks in the year immediately before the AP course is introduced, as shown in Figure 3. This may indicate that the hiring of new teachers facilitates the introduction of an AP course, or alternatively, that schools anticipate adding an AP course and hire new teachers as part of their preparation.

While I cannot observe principal hires in the data, I can track the hiring of "administrators," defined as individuals employed in non-teaching roles within the district. There is some evidence of a slight increase in the share of new administrators in the district leading up to the addition of an AP course, followed by a modest decline in subsequent years. However, this pattern is less distinct.

# 5 Results

## 5.1 Impact of AP Courses on Lower-Income Students' Classroom, Subject and School Income Composition

After the initial addition of an AP course, the number of AP courses in the subject area grows, reaching approximately 1.5 courses by the fourth year, as shown in Figure 4.[17] This sustained increase suggests that the addition of an AP course is not a temporary change, on average. The introduction of an AP course increases AP enrollment among lower-income students by roughly 5 percentage points. The increase in AP course enrollment is similar for both higher- and lower-income students as shown in Figure 5. Lower-income students with higher eighth-grade reading test scores are more likely to enroll in AP courses overall. As shown in Figure 7(a), lower-income students who scored in the bottom and top quintile of the grade 8 reading test are 3.8 and 10.6 percentage points more likely to enroll in an AP course following the addition of an AP course in the subject area.

The results indicate that adding an AP course does not decrease lower-income students' share of upper-income classmates. If anything, the addition of an AP course seems to increase lower-income students' exposure to upper-income classmates, measured by the share of a student's total classmates in the subject area who are upper-income. The increase in exposure to upper-income students unfolds gradually, stabilizing around the sixth year at 2 percentage points, as shown in Figure 5. Following the addition of an AP course, lower-income students' average share of higher-income classmates increased by 1 percentage point ($p < 0.001$)—a 9% increase in the share of upper-income classmates. I find a similar impact on lower-income students' share of upper-income classmates if I define exposure as the share of total classmates in the school (not only in the treated subject) who are upper-income as shown in Table **??**.[18]

The increase in exposure to upper-income classmates for lower-income students may arise from two primary mechanisms: (1) a composition shift, whereby the addition of an AP course increases the share of upper-income students participating in the subject area, and (2) a sorting change, whereby income-based sorting within the subject increases. I define sorting as the difference between the average proportion of upper-income classmates in upper- relative to lower-income students' classrooms in a subject area.[19]

[17] 85% of treated subjects add only one course in the first year an AP course is added.

[18] We might be concerned that lower-income students in treated subjects may be more likely to be higher-achieving following the addition of an AP course in the subject, and so happen to share more classrooms with upper-income students. To address this concern I also look at the average lower-income students' share of upper-income classmates independent of if the lower-income student enrolls in the treated subject or not. I similarly find that the average lower-income students' share of upper-income classmates increased by 0.93 percentage points following the addition of an AP course as shown in Table **??**.

[19] This measure of sorting is very similar to the variance ratio, but instead of looking at the difference between upper- and all other income students' classrooms, I look at upper- relative to lower-income students' classrooms. Here I look at the difference in peer composition and do not include students' own income status.

Evidence supports both mechanisms. Following the addition of an AP course, the proportion of higher-income students enrolled in treated school subjects rises by 1.13 percentage points, as shown in Table 3, consistent with a composition change. Additionally, there is evidence of an increase in income-based sorting within the subject: the difference in the proportion of upper-income classmates between upper- and lower-income students widens by 0.52 percentage points, as shown in Table 3. This suggests that, although income sorting slightly increases after adding an AP course, the increase in the share of upper-income students in the subject area helps to offset this effect, resulting in an overall increase in cross-income exposure.

The increase in the share of upper-income students in the subject area may result from shifts in students' course-taking patterns, without any change in the overall school composition—that is, students may simply be redistributing across classrooms. To determine if the school composition itself changes, I examine the effect of adding an AP course in a subject on the share of upper-income students in the entire school. The results, shown in Table 3, indicate that following the introduction of an AP course in a subject area, the proportion of upper-income students enrolled in the school increased by 0.97 percentage points. As such, the rise in exposure to upper-income peers may be driven, at least in part, by a growing share of upper-income students choosing to enroll in the school. Table **??** shows that following the addition of an AP course the number of upper-income students in the school increases by about

The increase in the share of upper-income students in treated subjects (where an AP course is added) is slightly larger at 1.13 percentage points than the increase in the share of upper-income students in the school (0.97 percentage points). The 1.13 percentage point increase in share of upper-income students in treated subjects is also slightly larger than the 1.0 percentage point increase in lower-income students' share of upper-income classmates in treated subjects, suggesting that in the absence of sorting by income lower-income students would have been exposed to slightly more upper-income students in treated subjects.

The addition of an AP course may attract or retain students in a high school who would have otherwise chosen to attend another school within the same district. Alternatively, it may draw higher-income students from neighboring districts or those who would have otherwise attended private schools. I find that the addition of an AP course increases the share of upper-income students in the district by 0.56 percentage points, with no detectable impact on other schools within the district, as shown in Table 4. The increase in the share of upper-income students in the district suggests that the observed increase in the share of upper-income students may be driven by higher-income students who would have otherwise attended private schools or enrolled in another district. This finding aligns with the prediction by Epple, Newlon, and Romano (2002) that increased tracking can attract or retain higher-income students in public schools.

The impact of adding AP coursework on the share of higher-income students may vary by subject area.

For example, in subjects such as mathematics, where AP enrollment may rely heavily on prior preparation, lower-income students may benefit less from the addition of AP courses. The observed increase in exposure to higher-income students is primarily driven by AP courses in science, foreign languages, technology and fine arts, as shown in Figure 8.

The increase in the share of upper-income classmates following the introduction of an AP course appears consistent across students with varying test scores, as shown in Figure 7(b) and Table 5. This pattern is consistent with the notion that the addition of an AP course led to an overall increase in the proportion of upper-income students in the school. Consequently, regardless of whether a student enrolls in an AP course, they are more likely to share a classroom with upper-income peers.

The identification assumption for these results requires that the observed impacts stem from the AP course addition rather than from other simultaneous school-level changes. It is possible that AP courses are introduced alongside other changes——such as a new principal or the arrival of an experienced teacher——that could also affect outcomes. Some of these simultaneous changes, like hiring a new teacher, could be thought of as part of the "treatment package"—what would need to take place for an advanced course to be added. That said, it is important to understand what part of this package may be driving the estimates. I include teacher-school-subject fixed effects to isolate the impact of AP course additions accounting for teacher changes. The estimates remain consistent, though slightly smaller, with the inclusion of teacher fixed effects: following the addition of an AP course, lower-income students experience an increase of 0.7 percentage points ($p < 0.01$) in the share of upper-income classmates. The continued positive impact of AP courses on the share of upper-income students, even when controlling for teacher effects, suggests that the estimates are not solely driven by changes in teacher quality.

Adding an AP course appears to increase the total number of courses offered in a school subject area by approximately six courses. The increase in number of courses suggests that the addition of an AP course is not merely a rebranding or substitution of an existing course but represents a genuine expansion of course offerings. However, it also raises the possibility that the observed change in exposure to upper-income students could be driven by the simultaneous increase in course options, rather than the specific characteristics of the AP course itself. Note that the increase in the number of courses offered is larger than the increase in the number of AP courses. To address this concern, in Model (2) of Table 3, I control for the total number of courses offered in a school subject in a given year. The estimates remain consistent with when controlling for the number of courses offered, suggesting that the observed change in the share of upper-income students is likely attributable to the AP course rather than the general increase in the number of courses.

Because schools tend to add an AP course in their earlier years (20% of schools add an AP course in their second year, as shown in Figure 1), the estimates might be influenced by new schools undergoing multiple simultaneous changes. To test this, I exclude new schools (defined as those open for three years or less by 2011) from the analysis. The results remain consistent: the share of upper-income classmates for lower-income students increases following the addition of an AP course by 1.2 percentage points, as shown in Figure 10, panel (a) and Table A6.

Another concern is that the results may be driven by schools experiencing an increase in the share of upper-income students in the years just prior to the addition of an AP course. To address this, I exclude treated schools that exhibit a positive trend ($slope >= 0.001$) in the share of upper-income students during the four years preceding the addition of an AP course ($t = -4$ to $t = -1$). Even after excluding these schools, the trend of increasing upper-income classmates for lower-income students following the addition of an AP course remains consistent, as shown in Figure 10, panel (b).

## 5.2 Impact of AP Courses on Lower-Income Students' Exposure to Higher-Achieving Students

Epple, Newlon, and Romano (2002) hypothesize that tracking in public schools retains higher-income, higher-achieving students who might otherwise attend private schools. However, they also suggest that higher-income, lower-achieving students may leave public schools in favor of less-tracked private school environments. Contrary to this prediction, I find that the increase in the share of upper-income students following the addition of an AP course is primarily driven by upper-income students who are not higher-achieving (i.e., those who scored below the 75th percentile on their grade 8 test scores).

The observed increase in lower-income students' exposure to upper-income classmates does not appear to be driven by higher-achieving students. Higher-achieving students are defined as those who scored in the top 25th percentile of their grade 8 test scores, based on the distribution of scores in the full sample. I find evidence of a modest (0.3 percentage point) increase in the share of higher-achieving, upper-income students following the addition of an AP course, as shown in Table 7. Thus, the overall increase in the share of upper-income students seems to be largely driven by upper-income students scoring below the 75th percentile on grade 8 reading tests.[20]

I also find a slight decrease in lower-income students' exposure to higher-achieving classmates following the addition of an AP course (-0.8 percentage points), as shown in Table 6. However, this decrease appears to

[20] The estimates are similar when using grade 8 math test scores, as shown in Table A5.

be temporary, returning to approximately zero by the sixth year after the AP course is added, as illustrated in Figure 11. The decrease in the share of higher-achieving students seems to be driven by new schools (schools that were open for three years or less by 2011). As shown in Table A6, the decrease in the share of higher-achieving students is halved when excluding new schools, and the coefficient becomes insignificant.

Additionally, I find no evidence of changes in the level of sorting by test score following the addition of an AP course, as shown in Table 6. Sorting by test score is defined as the difference in the share of higher-achieving students in the school between higher-achieving (75th percentile) and lower-achieving (25th percentile) students, based on grade 8 reading scores.[21]

## 6 Discussion and Conclusion

This study examines the impact of adding AP courses on lower-income students' classroom composition, specifically their exposure to upper-income and higher-achieving peers, by leveraging variation in the timing of AP course additions across schools and subject areas in Texas. Following the addition of an AP course, I find that lower-income students' share of upper-income classmates increases. This increase, driven primarily by a rise in the overall share of upper-income students in the school, offsets any increase in income-based sorting within the subject area.

The findings contribute to a nuanced understanding of how advanced coursework shapes school and classroom student demographics. Prior research has largely focused on the effects of advanced coursework on college enrollment and student performance, often overlooking the implications for cross-group interactions. By examining how AP courses shape classroom environments, this study provides a more comprehensive perspective on their role in promoting educational equity.

These findings underscore the importance of considering both within-school sorting and broader school composition when evaluating the equity implications of advanced coursework. The results suggest that introducing AP courses can enhance lower-income students' exposure to upper-income peers without substantially increasing income or achievement-based segregation within schools. Additionally, the findings highlight that advanced coursework may serve as a tool to attract and retain upper-income families in public schools, potentially reducing the socioeconomic stratification between public and private education systems.

While the evidence suggests that the package of changes typically accompanying the addition of an AP course slightly increases lower-income students' exposure to upper-income peers, the identification strategy makes it challenging to isolate whether the impact is driven solely by the AP course itself. For example,

[21] The estimates are consistent when using math test scores, as shown in Table A5.

unobserved factors such as changes in school leadership or other administrative priorities that coincide with the addition of an AP course may also contribute to making the school more attractive to upper-income students.

Future research could expand on this work by exploring the long-term impacts of AP course additions on lower-income students' college enrollment and employment, and how if it all it may be mediated by changes in classroom composition. Ultimately, this study challenges the common assumption that advanced courses will necessarily decrease lower-income students' exposure to upper-income peers by increasing sorting by income. It highlights the potential for advanced coursework to serve as a lever for promoting economic integration in schools.

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## 8 Main Tables and Figures

Table 1: High School Student Courses by Grade (2019)

| Variable | G9 | G10 | G11 | G12 |
|---|---|---|---|---|
| Total Courses Enrolled In | 8.21 | 8.265 | 8.110 | 7.826 |
| | (1.637) | (1.688) | (1.803) | (1.902) |
| Total Advanced Courses | .224 | .418 | 1.161 | 1.565 |
| | (.487) | (.78) | (1.655) | (1.842) |
| Total AP Courses | .143 | .311 | .743 | .906 |
| | (.38) | (.644) | (1.269) | (1.565) |
| Total IB Courses | 0 | .001 | .07 | .062 |
| | (.013) | (.048) | (.608) | (.587) |
| Total Advanced (Other) Courses | .081 | .105 | .348 | .598 |
| | (.284) | (.34) | (.569) | (.746) |
| Total Dual-Credit Courses | .257 | .521 | 1.772 | 2.28 |
| | (.619) | (.964) | (1.459) | (1.625) |
| Total ELA Courses | 2.37 | 2.355 | 2.343 | 2.243 |
| | (.895) | (.887) | (.916) | (.963) |
| Total Math Courses | 2.053 | 2.07 | 2.054 | 1.774 |
| | (.531) | (.566) | (.672) | (1.017) |
| Total Science Courses | 1.985 | 2.044 | 1.938 | 1.239 |
| | (.394) | (.564) | (.94) | (1.188) |
| Total Social Studies Courses | 1.897 | 2.069 | 2.332 | 2.193 |
| | (.577) | (.738) | (.944) | (1.001) |
| Total Foreign Language Courses | 1.418 | 1.322 | .671 | .275 |
| | (.968) | (1.001) | (.982) | (.727) |
| Total Fine Arts Courses | 1.291 | 1.229 | 1.084 | .92 |
| | (1.228) | (1.313) | (1.391) | (1.392) |
| Total Technology Courses | .109 | .102 | .103 | .083 |
| | (.457) | (.479) | (.508) | (.461) |
| Total Physical Ed. and Health Courses | 1.66 | 1.079 | .810 | .594 |
| | (.968) | (1.04) | (1.004) | (.893) |
| Total Business Courses | 0 | 0 | 0 | 0 |
| | (0) | (0) | (0) | (0) |
| Total CTE Courses | 1.675 | 2.245 | 2.635 | 2.753 |
| | (1.392) | (1.695) | (1.981) | (2.187) |
| Number of Students | 431824 | 396810 | 369572 | 344011 |

*Notes.* Table summarizes high school students' course patterns who are enrolled in Texas public schools in 2019. The course categorizations are based on Texas grouping of courses to subject areas. The number in brackets is the standard deviations from the mean. In Table A2 I split the summary statistics further by income group.

Table 2: Student Demographics by Subject-Area Treatment Status

| Variable | Control | Later Treated | Always Treated |
|---|---|---|---|
| Higher-Income Students | .243 | .255 | .282 |
| | (.429) | (.436) | (.45) |
| Lower-Income Students | .265 | .304 | .287 |
| | (.441) | (.46) | (.452) |
| Hispanic Students | .396 | .469 | .506 |
| | (.489) | (.499) | (.5) |
| Black Students | .093 | .121 | .139 |
| | (.291) | (.326) | (.346) |
| White Students | .502 | .39 | .313 |
| | (.5) | (.488) | (.464) |
| ESL Students | .041 | .047 | .082 |
| | (.197) | (.211) | (.274) |
| Std. Reading Score G8 | .174 | .136 | .049 |
| | (.802) | (.825) | (.942) |
| Std. Math Score G8 | .154 | .12 | .12 |
| | (.907) | (.936) | (.949) |
| Missing Reading Score G8 | .121 | .078 | .137 |
| | (.327) | (.267) | (.344) |
| Missing Math Score G8 | .129 | .082 | .145 |
| | (.336) | (.275) | (.352) |
| Number of Students | 976584 | 1109609 | 5615235 |
| Number of Subject-Areas | 3794 | 898 | 6687 |
| Number of Schools | 1142 | 581 | 1475 |

*Notes.* Table summarizes demographics of students in always treated, later treated and control subject areas. The averages and number of students are based on all years in the sample from 2011 to 2022 (including post-period for treated students).

Table 3: Impact of Addition AP Course on Lower-Income Students' AP Course Enrollment, Classroom, Subject and School Share Higher-Income

| | (1) | (2) |
|---|---|---|
| AP Course Enrollment | 0.0533 | 0.0535 |
| | (0.00451) | (0.00452) |
| Control Mean | 0 | 0 |
| N Clusters | 1320 | 1320 |
| Proportion Higher-Income Classmates in Subject | 0.0100 | 0.0101 |
| | (0.00323) | (0.00334) |
| Control Mean | 0.110 | 0.110 |
| N Clusters | 1320 | 1320 |
| Proportion Higher-Income in Subject | 0.0113 | 0.00981 |
| | (0.00353) | (0.00360) |
| Control Mean | 0.122 | 0.122 |
| N Clusters | 1320 | 1319 |
| Proportion Higher-Income in School | 0.00969 | 0.00916 |
| | (0.00328) | (0.00342) |
| Control Mean | 0.120 | 0.120 |
| N Clusters | 1320 | 1320 |
| Sorting by Income | 0.00517 | 0.00379 |
| | (0.00205) | (0.00221) |
| Control Mean | 0.0235 | 0.0235 |
| N Clusters | 1320 | 1320 |

The table captures the impact of the addition of an AP course on students' share of higher-income students across courses taken that year in a subject. The estimates are based on coefficient $beta_t$ from equation 1 for post-treatment indicator (post first AP course addition in subject) for lower-income students. Model (2) additionally controls for the number of courses offered in a given year in a school subject. The sorting outcome is based on the difference in exposure to upper-income students between lower- and upper-income students in the same school subject. I imputed the sorting outcome with 0 if a school does not have either lower- or upper-income students in a given year. Standard errors in parentheses are clustered at the school-level. Number of clusters is based on the number of schools. Control Mean is based on treated units average at $t = -1$.

Table 4: Impact of Addition AP Course on Lower-Income Students' District Composition

| | (1) | (2) |
|---|---|---|
| Proportion Higher-Income in District | 0.00557 | 0.00515 |
| | (0.00310) | (0.00314) |
| Control Mean | 0.140 | 0.140 |
| N Clusters | 1320 | 1320 |
| Proportion Higher-Income in Other (Not Treated) District School | -0.000647 | 0.0000503 |
| | (0.00554) | (0.00530) |
| Control Mean | 0.120 | 0.120 |
| N Clusters | 451 | 451 |

Similar to Table 3 looking at the impact on district share of upper-income students and the share of upper-income students in other schools in the district excluding treated school. The number of clusters is smaller for the impact on the share of upper-income students because a number of schools are the only schools.

Table 5: Impact of the Addition of an AP Course on Lower-Income Students: By Test-Score

| | (1) Q1: Bottom Test-Score | (2) Q2 | (3) Q3 | (4) Q4 | (5) Q5: Top Test-Score |
|---|---|---|---|---|---|
| AP Course Enrollment | 0.0348 | 0.0434 | 0.0589 | 0.0771 | 0.0978 |
| | (0.00347) | (0.00379) | (0.00475) | (0.00625) | (0.00817) |
| Control Mean | 0 | 0 | 0 | 0 | 0 |
| N Clusters | 1259 | 1245 | 1250 | 1238 | 1200 |
| Proportion Upper-Income Classmates | 0.0109 | 0.00921 | 0.0109 | 0.0113 | 0.00585 |
| | (0.00310) | (0.00329) | (0.00371) | (0.00386) | (0.00353) |
| Control Mean | 0.0900 | 0.110 | 0.120 | 0.120 | 0.120 |
| N Clusters | 1259 | 1245 | 1250 | 1238 | 1200 |

The table captures the impact of the addition of an AP course on students' AP course enrollment and share of higher-income classmates on lower-income students. Lower-income students are split into five subgroups based on the distribution of grade 8 reading test-scores in the full sample. Standard errors in parentheses are clustered at the school-level. Control Mean is based on treated units average at $t = -1$.

Table 6: Impact of Addition AP Course on Lower-Income Students' Classroom, Subject and School Share Higher-Achieving (Reading)

| | (1) | (2) |
|---|---|---|
| Proportion Higher-Achieving Classmates in Subject | -0.00870 | -0.00756 |
| | (0.00448) | (0.00435) |
| Control Mean | 0.180 | 0.180 |
| N Clusters | 1320 | 1320 |
| Proportion Higher-Achieving in Subject | -0.00913 | -0.00940 |
| | (0.00473) | (0.00460) |
| Control Mean | 0.190 | 0.190 |
| N Clusters | 1320 | 1320 |
| Proportion Higher-Achieving in School | -0.00930 | -0.00923 |
| | (0.00434) | (0.00419) |
| Control Mean | 0.190 | 0.190 |
| N Clusters | 1320 | 1320 |
| Sorting by Achievement | 0.00168 | -0.000977 |
| | (0.00470) | (0.00471) |
| Control Mean | 0.0800 | 0.0800 |
| N Clusters | 1320 | 1320 |

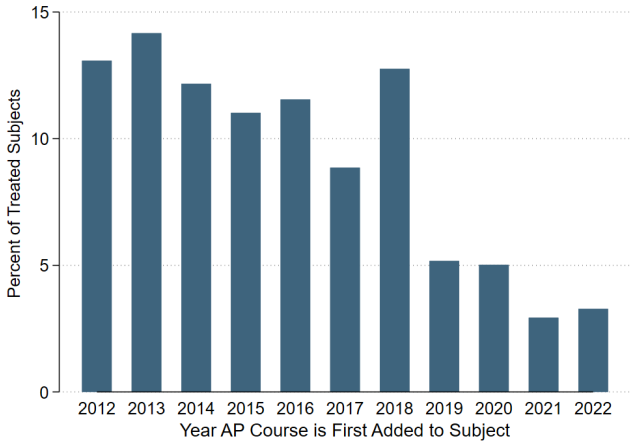
Similar to Table 3 but looking at the share of higher-achieving students instead of the share of higher-income students. A student is defined as higher-achieving if they scored in the top 25th percentile of their grade 8 reading test-score based on the distribution of student test-scores in the full sample in a given year. Sorting by income is the difference between the average share of higher-achieving students in 25th compared to the 75th percentile students based on their grade 8 reading test-scores. Table A5 in the appendix uses math score instead of reading.

Table 7: Impact of Addition AP Course on Lower-Income Students' Classroom, Subject and School Share Higher-Income Higher-Achieving (Reading)

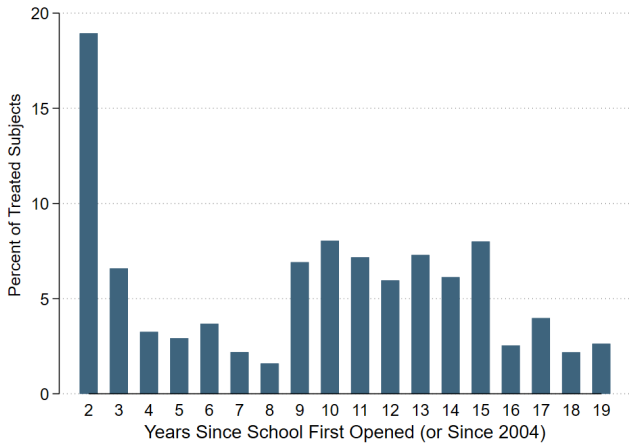
| | (1) | (2) |
|---|---|---|
| Proportion Higher-Income and -Achieving Classmates in Subject | 0.00265 | 0.00274 |
| | (0.00140) | (0.00143) |
| Control Mean | 0.0300 | 0.0300 |
| N Clusters | 1320 | 1320 |
| Proportion Higher-Income and -Achieving in Subject | 0.00288 | 0.00250 |
| | (0.00180) | (0.00180) |
| Control Mean | 0.0400 | 0.0400 |
| N Clusters | 1320 | 1320 |
| Proportion Higher-Income and -Achieving in School | 0.00139 | 0.00122 |
| | (0.00147) | (0.00149) |
| Control Mean | 0.0400 | 0.0400 |
| N Clusters | 1320 | 1320 |

Similar to Table 3 but looking at the share of higher-income higher-achieving students instead of the share of higher-income students. A student is defined as higher-achieving if they scored in the top 25th percentile of their grade 8 reading test-score based on the distribution of student test-scores in the full sample in a given year. Table A5 in the appendix uses math score instead of reading.

Figure 1: Timing of AP Course Addition



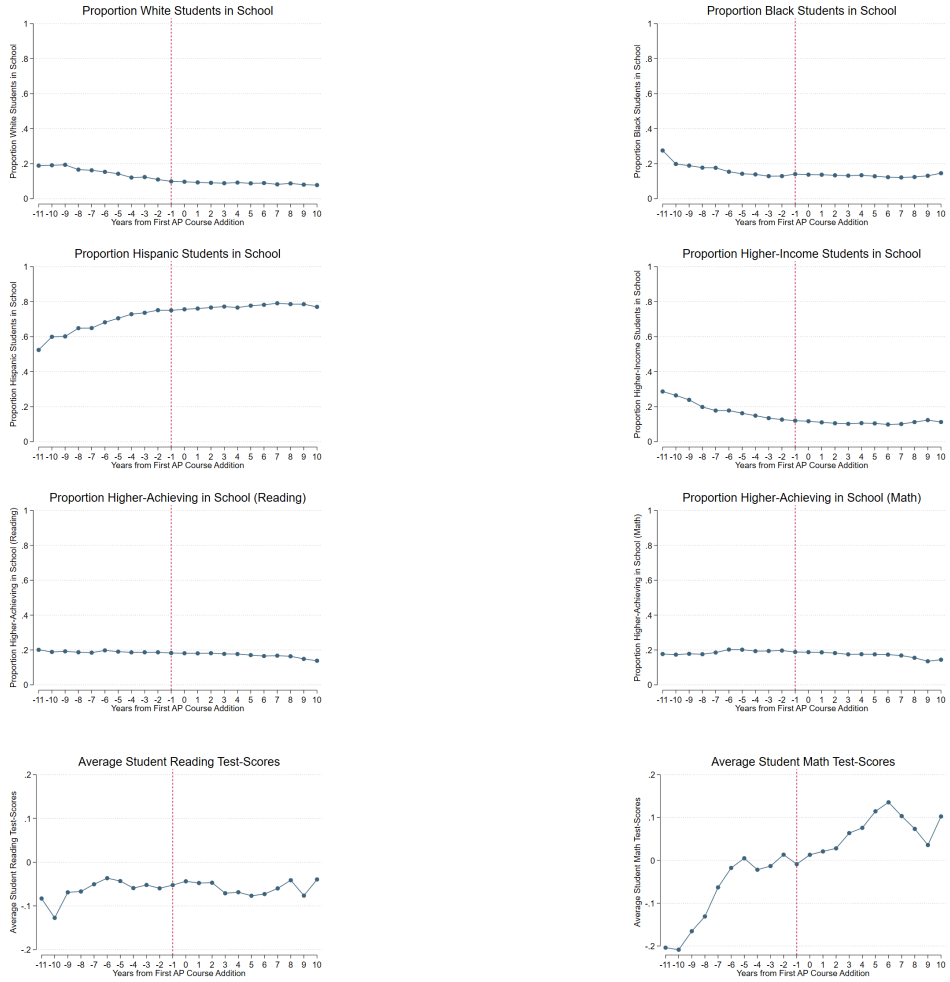

(a) Year School Subject First Adds an AP Course




(b) Year Relative to School Opening When an AP Course is Added

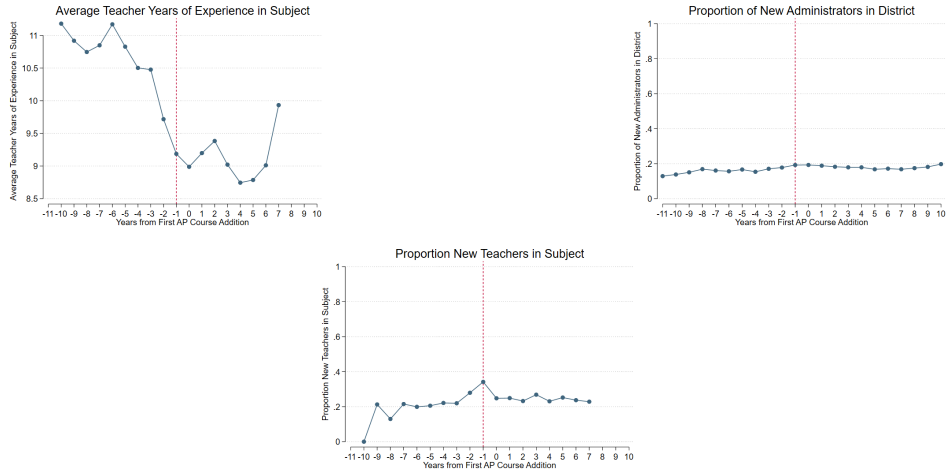
*Notes:* The histograms capture the timing of when AP courses are first added to a subject. In panel (a) I present the percentage of school subjects that first add an AP course in each year. In panel (b) I present when an AP course is first added relative to school opening year if the school opened after 2004. If the school first opened in 2004, then it shows the number of after 2004 the AP course is first added in the school subject.

Figure 2: Trends in Student Composition Leading Up to the Addition of an AP Course



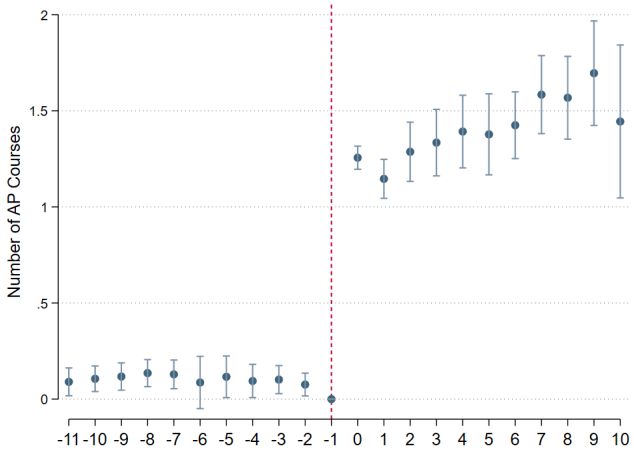

*Notes:* Each figure presents a change in the average student composition averaged across all treated schools at time $t$ where $t = 0$ is when an AP course is first added to a school subject.

Figure 3: Trends in Teacher and Administration Entry Leading Up to the Addition of an AP Course



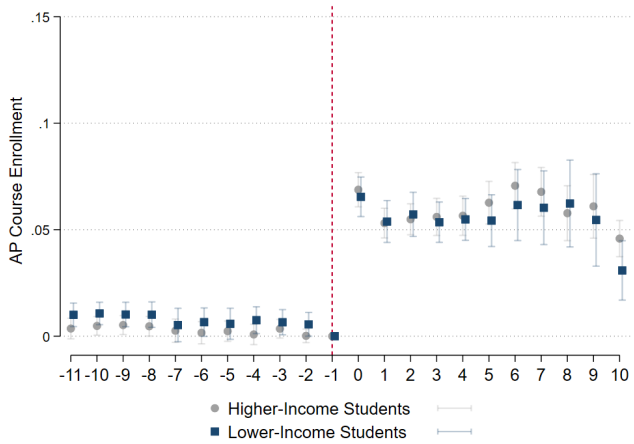

*Notes:* Each figure presents a change in the average student composition averaged across all treated schools at time $t$ where $t = 0$ is when an AP course is first added to a school subject. The teacher averages are based on the treated subject average. Teachers are linked to student classroom data. A new teacher is defined as a teacher who is first observed in a treated school, since the teacher data can only be linked to students starting 2012, at $t = -10$ I cannot determine if a teacher was enrolled in that same school the prior year, which is why the proportion of new teacher is imputed at 0 that year. I cannot observe administrators role in the data or what school they are assigned, only the district they are assigned. As such, a new administrator is defined as an administrator that was not observed in the treated district in the prior year.

Figure 4: Impact of AP Course Addition on the Number of AP Courses Offered in Subject-Area



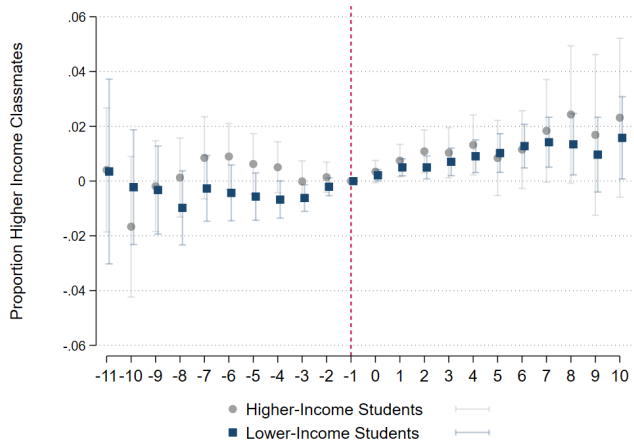

*Notes:* Plot captures the impact on the number of AP courses offered in a subject-area after an AP course is first added in $t = 0$. Average is weighted by the number of students enrolled. The 95% confidence is based on the standard errors of the coefficients from the regression, clustered at the school-level. The comparison school subject areas are those never treated.

Figure 5: Impact of AP Course Addition on the Likelihood of Enrolling in an AP Course



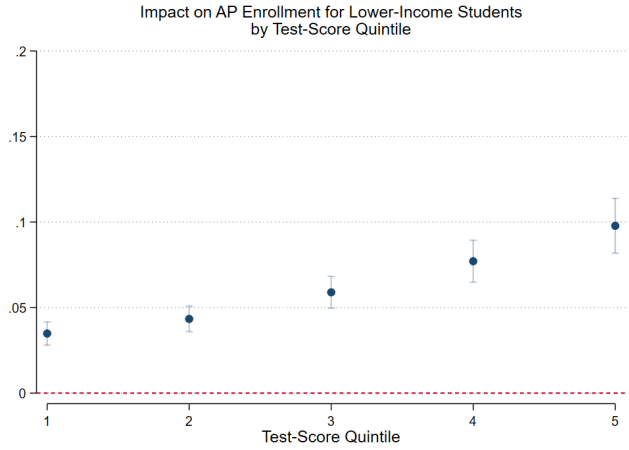

*Notes:* This event plot captures the impact of treatment on students' likelihood of enrolling in AP course. Plot is based on coefficients $beta_t$ from equation 1 for each income group with the outcome being a binary variable that takes on a value of 1 if a student is enrolled in any AP class in the subject area. The blue dots and lines present the estimates for lower-income students–always on free/reduced lunch status. The grey dots present the estimates for higher-income students–students never on free/reduced lunch status. The regression includes one observation per student subject-area enrollment. The 95% confidence is based on the standard errors of the coefficients from the regression, clustered at the school-level. The comparison school subject areas are those never treated.

Figure 6: Impact of AP Course Addition on Exposure to Higher-Income Students

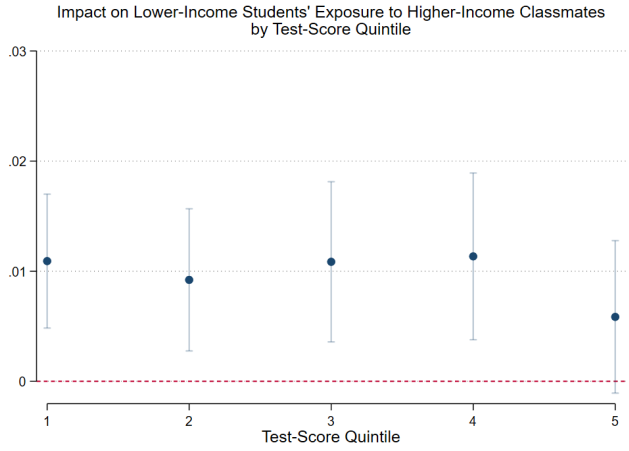



*Notes:* The event plot is similar to Figure 5 with the outcome being students' subject-area average proportion of higher-income classmates.

Figure 7: Impact of AP Course Addition on Lower-Income Students by Student G8 Test-Score



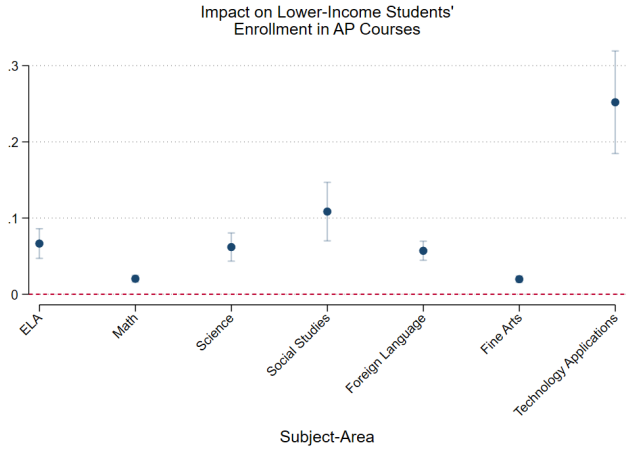

(a) Enrolled in AP Course



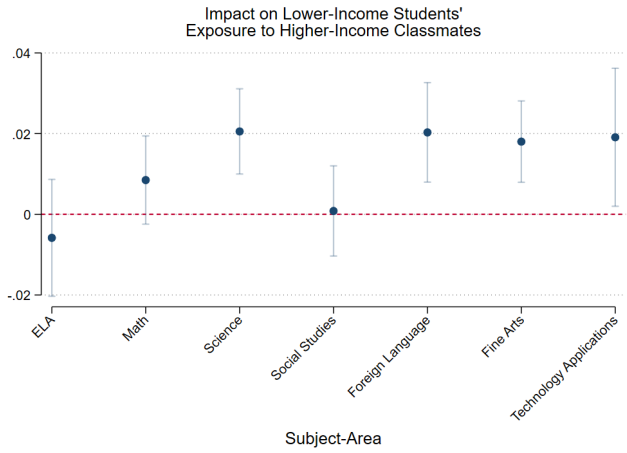

(b) Proportion Higher-Income students

*Notes:* The plots capture the overall average impact post-treatment for lower-income students in each test-score. The coefficients are based on running the regression with a post-treatment indicator with the same regression specifications as in equation 1. Test-scores are based on grade 8 reading test-scores. Test-scores are missing for 8% of students.

Figure 8: Impact of AP Course Addition on Lower-Income Students by Subject-Area



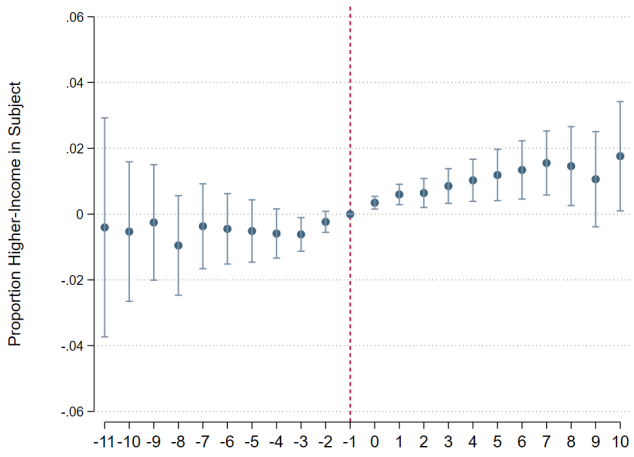

(a) Enrolled in AP Course



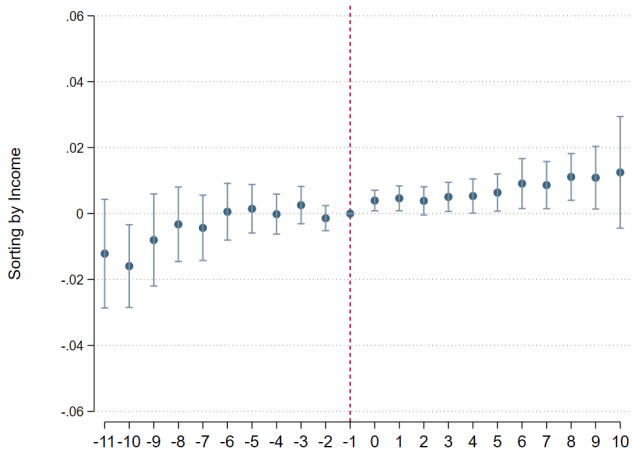

(b) Proportion Higher-Income students

*Notes:* The plots capture the overall average impact post-treatment for lower-income students in each subject-area. The coefficients are based on running the regression with a post-treatment indicator with the same regression specifications as in equation 1 in separate regression for each subject-area.

Figure 9: Impact of the Addition of AP course on Subject Area Composition and Sorting by Income



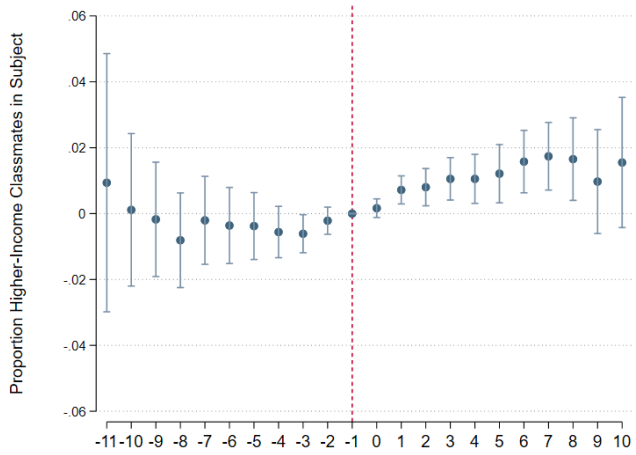

(a) Proportion Higher-Income Students in Subject



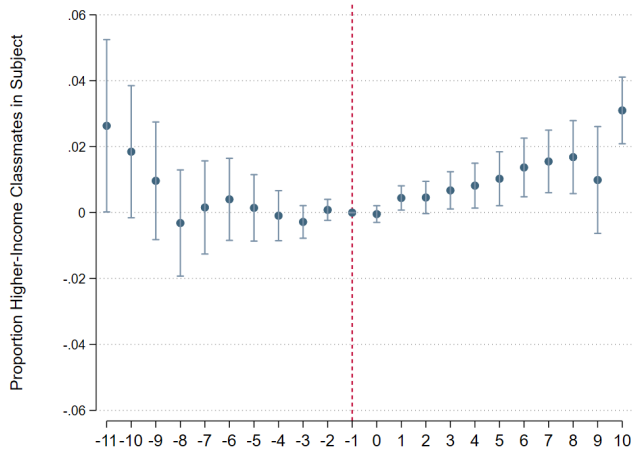

(b) Sorting: Difference in Share of Higher-Income Peers Between Higher- and Lower-Income Students

*Notes:* Panel (a) outcome is the share of total classroom student enrollments in the subject area who are higher-income. Panel (b) outcome is the difference in the proportion of higher-income classmates in higher- relative to lower-income students' classrooms in a given year. Estimates are weighted by the number of lower-income students enrolled in the subject area in a given year. This number captures the change in the level of sorting by income between classrooms in a subject area across time. The 95% confidence is based on the standard errors of the coefficients from the regression, clustered at the school-level. The comparison school subject areas are those never treated.

Figure 10: Impact of AP Addition on Lower-Income Students' Proportion Upper-Income Classmates: Robustness to Sample Specification



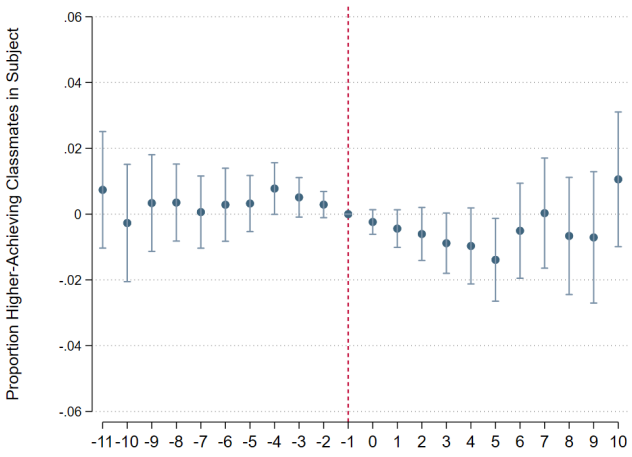

(a) Includes Only Schools that are 4-Years or Older



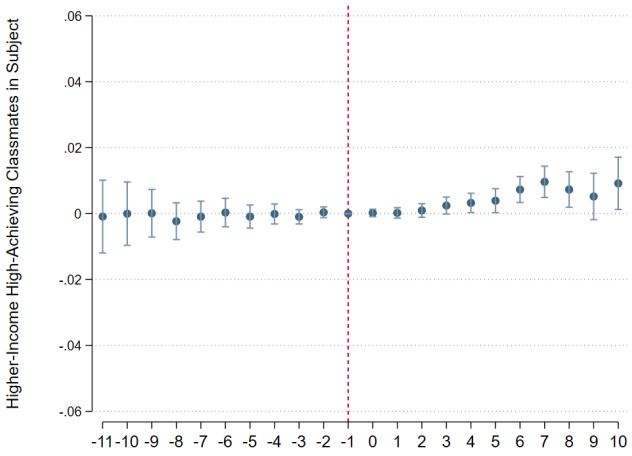

(b) Excludes Schools with Increasing Share of Upper-Income Students Prior to AP Addition

*Notes:* Panel (a) and (b) capture the change in the share of higher-income classmates prior to and after an AP course is first added in the subject. Panel (a) limits the sample to schools that are three years or older by 2011. Panel (b) excludes schools that in the period right before treatment ($t = -4 to -1$) had an increasing share of upper-income students in the school ($slope >= 0.001$).

Figure 11: Impact of AP Addition on Lower-Income Students' Share of Higher-Achieving Students




(a) Share of Higher-Achieving Students




(b) Share of Higher-Income and Higher-Achieving Students

*Notes:* Panel (a) outcome is the average share of higher-achieving classmates for lower-income students in the subject. Panel (b) outcome is average share of higher-income and higher-achieving classmates for lower-income students in the subject. Higher-achieving students are those who scored in the top 25th percentiles of their grade 8 reading test. Estimates are weighted by the number of lower-income students enrolled in the subject area in a given year. The 95% confidence is based on the standard errors of the coefficients from the regression, clustered at the school-level. The comparison school subject areas are those never treated.

# 9 Appendix

Table A1: High School Student Demographics: 2019

| Variable | Mean |
|---|---|
| Black Students | .149 |
| | (.356) |
| White Students | .305 |
| | (.461) |
| Hispanic Students | .517 |
| | (.5) |
| Title I School | .444 |
| | (.497) |
| Free/Reduced Lunch Status (2019) | .542 |
| | (.498) |
| Higher Income (Never on FRPL) | .253 |
| | (.434) |
| Lower Income (Always on FRPL) | .28 |
| | (.449) |
| Special Education | .089 |
| | (.284) |
| Gifted Program | .096 |
| | (.294) |
| English Language Learner | .158 |
| | (.365) |
| Any Vocational Ed | .769 |
| | (.421) |
| Enrolled in Charter School | .054 |
| | (.225) |
| Number of Students | 1542217 |

*Notes.* Table summarizes high school students' demographics who are enrolled in Texas public schools in 2019. The course categorizations are based on Texas grouping of courses to subject areas. The number in brackets is the standard deviations from the mean.

Table A2: High School Student Courses by Grade (2019): By Income

| | G9 | | G10 | | G11 | | G12 | |
|---|---|---|---|---|---|---|---|---|
| Variable | HI | LI | HI | LI | HI | LI | HI | LI |
| Total Courses Enrolled In | 7.923 | 8.37 | 7.95 | 8.477 | 7.781 | 8.351 | 7.483 | 8.179 |
| | (1.176) | (1.802) | (1.231) | (1.876) | (1.378) | (1.973) | (1.54) | (2.082) |
| Total Advanced Courses | .327 | .201 | .656 | .352 | 1.864 | .868 | 2.262 | 1.26 |
| | (.575) | (.465) | (.974) | (.700) | (1.972) | (1.399) | (2.153) | (1.591) |
| Total AP Courses | .251 | .105 | .522 | .236 | 1.246 | .532 | 1.504 | .652 |
| | (.486) | (.332) | (.807) | (.565) | (1.598) | (1.029) | (1.943) | (1.289) |
| Total IB Courses | 0 | 0 | .002 | .001 | .096 | .066 | .093 | .050 |
| | (.018) | (.014) | (.051) | (.055) | (.714) | (.592) | (.73) | (.523) |
| Total Advanced (Other) Courses | .076 | .096 | .132 | .115 | .522 | .27 | .665 | .558 |
| | (.278) | (.306) | (.375) | (.36) | (.633) | (.515) | (.782) | (.714) |
| Total Dual-Credit Courses | .151 | .33 | .321 | .668 | 1.579 | 1.939 | 2.156 | 2.354 |
| | (.478) | (.692) | (.737) | (1.087) | (1.326) | (1.556) | (1.534) | (1.699) |
| Total ELA Courses | 2.219 | 2.504 | 2.222 | 2.482 | 2.246 | 2.424 | 2.15 | 2.338 |
| | (.671) | (1.049) | (.691) | (1.038) | (.759) | (1.025) | (.791) | (1.096) |
| Total Math Courses | 2.03 | 2.074 | 2.058 | 2.078 | 2.051 | 2.063 | 1.759 | 1.815 |
| | (.359) | (.642) | (.43) | (.652) | (.547) | (.751) | (.926) | (1.086) |
| Total Science Courses | 1.995 | 1.967 | 2.077 | 2.028 | 2.006 | 1.927 | 1.297 | 1.232 |
| | (.241) | (.48) | (.51) | (.623) | (.968) | (.917) | (1.192) | (1.204) |
| Total Social Studies Courses | 1.926 | 1.871 | 2.075 | 2.077 | 2.336 | 2.342 | 2.184 | 2.235 |
| | (.474) | (.642) | (.672) | (.797) | (.909) | (.975) | (.944 | (1.056) |
| Total Foreign Language Courses | 1.626 | 1.292 | 1.373 | 1.281 | .621 | .738 | .216 | .361 |
| | (.852) | (1.021) | (.983) | (1.027) | (.959) | (1.018) | (.646) | (.830) |
| Total Fine Arts Courses | 1.427 | 1.201 | 1.322 | 1.157 | 1.175 | 1.025 | .994 | .886 |
| | (1.33) | (1.165) | (1.415) | (1.239) | (1.519) | (1.299) | (1.498) | (1.318) |
| Total Technology Courses | .18 | .082 | .193 | .059 | .181 | .064 | .13 | .061 |
| | (.601) | (.387) | (.667) | (.353) | (.687) | (.385) | (.589) | (.391) |
| Total Physical Ed. and Health Courses | 1.703 | 1.631 | 1.188 | 1.024 | .889 | .767 | .656 | .578 |
| | (.916) | (.997) | (1.039) | (1.038) | (1.026) | (.983) | (.916) | (.889) |
| Total CTE Courses | 1.503 | 1.756 | 2.048 | 2.353 | 2.389 | 2.752 | 2.351 | 3.019 |
| | (1.381) | (1.388) | (1.655) | (1.712) | (1.952) | (1.976) | (2.033) | (2.266) |
| Number of Students | 97500 | 129471 | 98781 | 110809 | 97848 | 100028 | 95373 | 91633 |

*Notes.* Similar to Table 1 but with summary statistics further split by students' income.

Table A3: High School Average of Number of Courses Offered in 2019

| Variable | Mean |
|---|---|
| Number of Courses | 96.949 |
| | (74.861) |
| Advanced Courses | 13.285 |
| | (15.574) |
| AP Courses | 6.652 |
| | (9.163) |
| IB Courses | .585 |
| | (3.431) |
| Advanced (Other) Courses | 6.048 |
| | (5.941) |
| ELA Courses | 11.632 |
| | (8.074) |
| Advanced ELA Courses | 1.915 |
| | (2.128) |
| Math Courses | 7.443 |
| | (3.436) |
| Advanced Math Courses | 2.309 |
| | (1.813) |
| Science Courses | 6.69 |
| | (3.733) |
| Advanced Science Courses | 1.438 |
| | (2.206) |
| Social Studies Courses | 9.048 |
| | (4.84) |
| Advanced Social Studies Courses | 2.16 |
| | (2.75) |
| Foreign Language Courses | 6.045 |
| | (6.586) |
| Advanced Foreign Language Courses | 1.251 |
| | (2.325) |
| Fine Arts Courses | 16.775 |
| | (18.471) |
| Advanced Fine Arts Courses | 3.375 |
| | (4.693) |
| Technology Courses | 1.264 |
| | (2.144) |
| Advanced Technology Courses | .688 |
| | (1.314) |
| Physical Ed. and Health Courses | 6.258 |
| | (4.46) |
| Advanced Physical Ed. and Health Courses | 0 |
| | (0) |
| Business Courses | 0 |
| | (0) |
| Advanced Business Courses | 0 |
| | (0) |
| CTE Courses | 29.333 |
| | (27.647) |
| Advanced CTE Courses | .106 |
| | (.422) |
| Number of Schools | 2285 |

*Notes.* Table summarizes the average number of courses offered in a high school in Texas in 2019. The number in brackets is the standard deviations from the mean.

Table A4: School Course Offering and Demographic: By Subject Area

| Subject | N. Courses | N. Classrooms | N. Stud | Prop HI | N. Schls |
|---|---|---|---|---|---|
| All | | | | | |
| Control | 4.325 | 16.301 | 43.13 | .245 | 1138 |
| | (3.997) | (19.082) | (62.151) | (.191) | |
| Treated | 6.561 | 31.658 | 98.543 | .26 | 578 |
| | (6.867) | (35.997) | (113.048) | (.219) | |
| English Language Arts | | | | | |
| Control | 5.403 | 24.756 | 74.691 | .242 | 381 |
| | (2.397) | (23.552) | (107.549) | (.188) | |
| Treated | 7.564 | 41.719 | 155.881 | .238 | 73 |
| | (4.141) | (34.467) | (179.228) | (.194) | |
| Math | | | | | |
| Control | 4.324 | 16.555 | 53.409 | .212 | 293 |
| | (1.388) | (14.712) | (71.242) | (.184) | |
| Treated | 4.569 | 24.016 | 90.889 | .264 | 81 |
| | (1.341) | (19.073) | (83.25) | (.206) | |
| Science | | | | | |
| Control | 3.183 | 12.754 | 44.377 | .221 | 384 |
| | (1.201) | (12.02) | (59.634) | (.17) | |
| Treated | 3.945 | 25.651 | 110.913 | .25 | 124 |
| | (1.458) | (24.704) | (116.865) | (.207) | |
| Social Studies | | | | | |
| Control | 5.559 | 21.699 | 64.539 | .252 | 417 |
| | (1.587) | (16.201) | (55.559) | (.171) | |
| Treated | 6.294 | 35.667 | 116.983 | .265 | 100 |
| | (1.67) | (28.68) | (93.811) | (.203) | |
| Foreign Language | | | | | |
| Control | 2.824 | 12.55 | 30.858 | .269 | 734 |
| | (1.252) | (9.378) | (33.751) | (.171) | |
| Treated | 5.305 | 32.936 | 96.388 | .274 | 128 |
| | (6.074) | (35.05) | (103.243) | (.214) | |
| Fine Arts | | | | | |
| Control | 7.786 | 25.802 | 51.967 | .233 | 793 |
| | (6.659) | (27.87) | (64.253) | (.168) | |
| Treated | 13.55 | 53.751 | 129.263 | .243 | 208 |
| | (9.694) | (48.291) | (119.333) | (.206) | |
| Technology Applications | | | | | |
| Control | 1.456 | 4.233 | 12.924 | .257 | 743 |
| | (.709) | (3.824) | (22.668) | (.247) | |
| Treated | 1.712 | 5.917 | 24.353 | .284 | 176 |
| | (.82) | (5.624) | (31.903) | (.264) | |

*Notes.* Table summarizes the number of subject areas in each group: treatment and control. It summarizes the number of courses, classrooms and students on average, in a given year for students who enroll in each subject area. For treated subject-areas the average is based on pre-treatment years.

Table A5: Impact of Addition AP Course on Lower-Income Students' Classroom Share Higher-Achieving (Math)

| | (1) | (2) |
|---|---|---|
| Proportion Higher-Achieving Classmates in Subject | -0.00436 | -0.00345 |
| | (0.00609) | (0.00601) |
| Control Mean | 0.180 | 0.180 |
| N Clusters | 1320 | 1320 |
| Proportion Higher-Income Higher-Achieving Classmates in Subject | 0.00152 | 0.00159 |
| | (0.00162) | (0.00166) |
| Control Mean | 0.0300 | 0.0300 |
| N Clusters | 1320 | 1320 |
| Sorting by Achievement | -0.00541 | -0.00544 |
| | (0.00630) | (0.00629) |
| Control Mean | 0.0800 | 0.0800 |
| N Clusters | 1320 | 1320 |

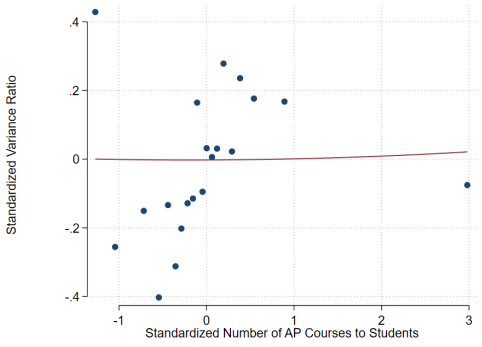
Similar to Table 6 and Table 7 but defining achievement by students' grade 8 math instead of reading test-scores. A student is defined as higher-achieving if they scored in the top 25th percentile of their grade 8 math test-score based on the distribution of student test-scores in the full sample in a given year. Sorting by income is the difference between the average share of higher-achieving students in 25th compared to the 75th percentile students based on their grade 8 math test-scores.

Table A6: Impact of Addition AP Course on Lower-Income Students' Classroom Share Higher-Income and Higher-Achieving Students [Excluding New Schools]

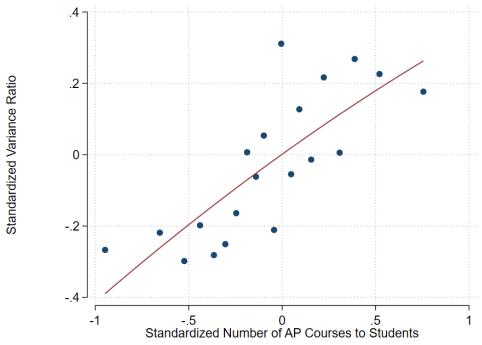
| | (1) | (2) |
|---|---|---|
| Proportion Higher-Income Classmates in Subject | 0.0119 | 0.0120 |
| | (0.00409) | (0.00420) |
| Control Mean | 0.120 | 0.120 |
| N Clusters | 994 | 994 |
| Proportion Higher-Achieving Classmates in Subject | -0.00389 | -0.00329 |
| | (0.00367) | (0.00364) |
| Control Mean | 0.160 | 0.160 |
| N Clusters | 994 | 994 |
| Proportion Higher-Income Higher-Achieving Classmates in Subject | 0.00241 | 0.00261 |
| | (0.00178) | (0.00180) |
| Control Mean | 0.0400 | 0.0400 |
| N Clusters | 994 | 994 |
| Sorting by Income | 0.00629 | 0.00501 |
| | (0.00263) | (0.00286) |
| Control Mean | 0.0310 | 0.0310 |
| N Clusters | 994 | 994 |
| Sorting by Achievement | 0.0000187 | -0.00337 |
| | (0.00590) | (0.00586) |
| Control Mean | 0.0884 | 0.0884 |
| N Clusters | 994 | 994 |

Similar to Table 3 and Table 7 but limiting the sample to schools that have been open for three years or longer by 2011.

Figure A1: Relationship between AP Courses to Students and Variance Ratio



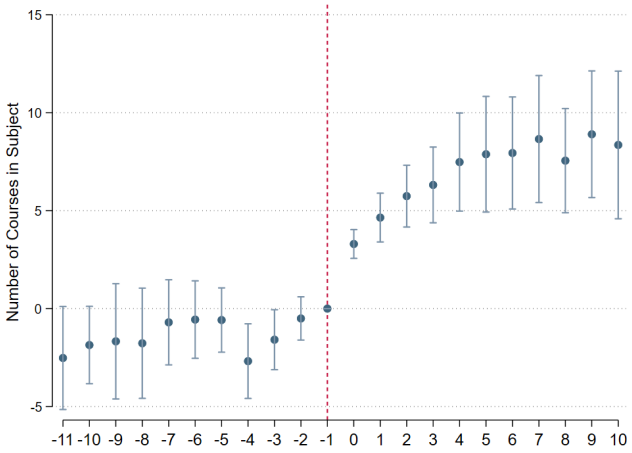

(a) Full Sample




(b) Excluding above 1 standard deviation AP courses to students and schools with no AP course offered

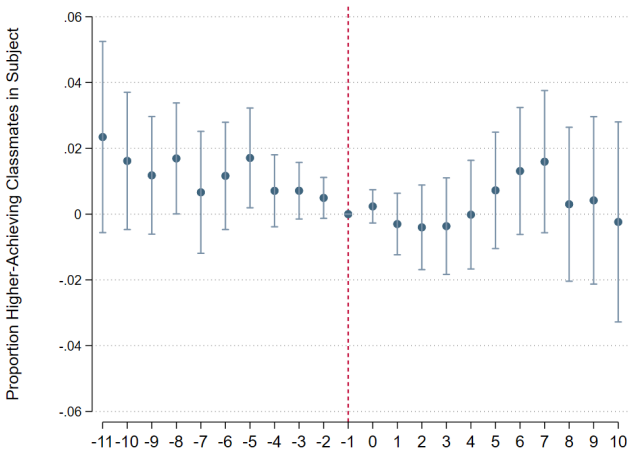
*Notes:* Based on 2019 high-school classroom enrollment data. Bins are based on grouping the x-values into 20 equal sized bins. It then computes the average y-variable value for that bin. Fitted line is weighted by the number of high-school students enrolled. Panel (a) plots the relationship between the number of AP courses to students and the full sample. Panel (b) limits the sample to schools offering at least one AP course, and below 1 standard deviations in terms of the number of AP courses they offer to students.

Figure A2: Number of Courses in Subject Area Post Treatment

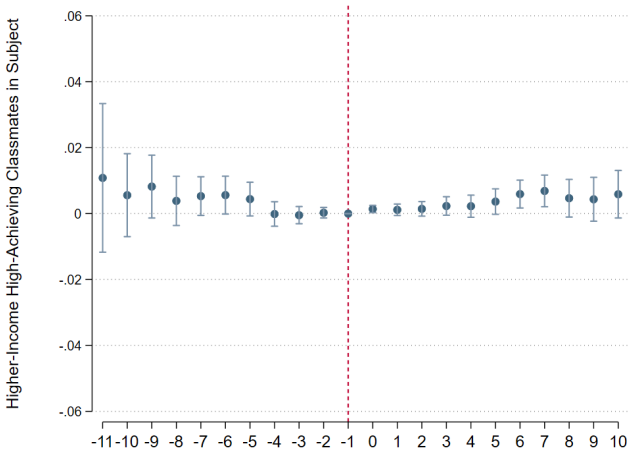



*Notes:* These event plot capture the impact of treatment on the number of courses in subject-area. The outcome is weighted by the number of lower-income students enrolled in the subject-area. The 95% confidence is based on the standard errors of the coefficients from the regression, clustered at the school-level. The comparison school subject areas are those never treated.

Figure A3: Impact of AP Addition on Lower-Income Students' Share of Higher-Achieving Students (Math)




(a) Share of Higher-Achieving Students




(b) Share of Higher-Income and Higher-Achieving Students

*Notes:* Panel (a) outcome is the average share of higher-achieving classmates for lower-income students in the subject. Panel (b) outcome is average share of higher-income and higher-achieving classmates for lower-income students in the subject. Higher-achieving students are those who scored in the top 25th percentiles of their grade 8 math test. Estimates are weighted by the number of lower-income students enrolled in the subject area in a given year. The 95% confidence is based on the standard errors of the coefficients from the regression, clustered at the school-level. The comparison school subject areas are those never treated.